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Effects of physical activity at work and life-style on sleep in workers from an Amazonian Extractivist Reserve☆

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ABSTRACT

Physical activity has been recommended as a strategy for improving sleep. Nevertheless, physical effort at work might not be not the ideal type of activity to promote sleep quality. The aim of this study was to evaluate the effects of type of job (low vs. high physical effort) and life-style on sleep of workers from an Amazonian Extractivist Reserve, Brazil. A cross-sectional study of 148 low physical activity (factory workers) and 340 high physical activity (rubber tappers) was conducted between September and November 2011. The workers filled out questionnaires collecting data on demographics (sex, age, occupation, marital status and children), health (reported morbidities, sleep disturbances, musculoskeletal pain and body mass index) and life-style (smoking, alcohol use and practice of leisure-time physical activity). Logistic regression models were applied with the presence of sleep disturbances as the primary outcome variable. The prevalence of sleep disturbances among factory workers and rubber tappers was 15.5% and 27.9%, respectively. The following independent variables of the analysis were selected based on a univariate model ($p < 0.20$): sex, age, marital status, work type, smoking, morbidities and musculoskeletal pain. The predictors for sleep disturbances were type of job (high physical effort); sex (female); age (> 40 years), and having musculoskeletal pain (≥5 symptoms). Rubber tapper work, owing to greater physical effort, pain and musculoskeletal fatigue, was associated with sleep disturbances. Being female and older than 40 years were also predictors of poor sleep. In short, these findings suggest that demanding physical exertion at work may not improve sleep quality.

1. Introduction

In recent years, sleep disturbances have been extensively reported in the literature, affecting all age groups. Numerous studies have reported a high prevalence of sleep problems in the general population with rates varying between 10–48% [1–4]. In Brazil, studies carried out in São Paulo city identified a prevalence of objective insomnia of 32% [5]. Moreover, a marked increase in sleep-related complaints was found, such as difficulties initiating and maintaining sleep [6].

Sleep deprivation negatively impacts quality of life, affecting the health of the population, and is associated with increased overweight and obesity, higher risk of cardiac and metabolic diseases, as well as greater risk of accidents in the workplace and higher health costs [7–9]. Studies have highlighted the practice of physical exercise as a factor that can enhance sleep quality and duration and reduce the prevalence of sleep disorders [10–12]. However, it has been suggested that not all physical activities improve sleep quality. Highly intense physical activity may have a negative effect on sleep when it is work-related. Geroldi et al. [13] reported that individuals with an occupational history of low physical effort exhibited better sleep quality compared to workers with physically demanding jobs. These findings suggest that physical activity is a way of improving sleep quality, provided these activities are moderate and taken during leisure rather than demanding and work-related.

Brazil has undergone an intense restructuring of the production chain involving the replacement of human labor by mechanized and technology-based work, where this has had a major impact on the lives of the population. These changes in the work sphere have led to shifts

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in the epidemiologic profile of the workers, with the emergence of new risks to health, such as an increase in neuromuscular diseases, psychosocial problems, among other health issues [14]. Nevertheless, few studies have explored the possible effects of changes in the physical characteristics of work, activity and life-style on sleep quality of workers, particularly in rural regions of the country. In this context, two occupational categories were investigated in this study: 1) rubber tappers, who work in an activity with high physical demand; 2) workers from a factory, who work in activities with low or moderate physical activity.

Rubber tappers are forest workers and dwellers living closely with nature and from which they derive their basic needs. Thus, rubber tappers live off Brazilian nuts, rubber and sustainable lumber and other subsistence-based agriculture (small scale farming) and extractivism (hunting and fishing) [15]. The daily working life of rubber tappers entails vigorous physical activity involving long treks carrying the material collected (latex, Brazilian nuts) and substantial expenditure of energy. Fishing, hunting, playing football and meeting friends were some of the leisure activities observed among rubber tappers. By contrast, factory workers perform more static repetitive activities involving long periods standing and have access to electronic devices (television sets, computers etc.) as a form of leisure, factors that reduce their overall energy expenditure in their daily lives.

The aim of the present study was to assess the effects of physical activity at work and life-style on sleep of workers with high and low/moderate physical demands living on the same Amazonian Extractivist Reserve.

2. Methods

A cross-sectional study of a typical rural population represented by a group of rubber tappers with known high physical workload was undertaken. Another group from a similar cultural background and state of Brazil were represented by factory workers with low or moderate physical workload living in a small town (also in the Amazonian Extractivist Reserve). Thus, the population comprising rubber tappers from the Amazon forest and factory workers of a rubber factory (where the latex was refined into rubber for commercial processing) located in Xapuri, Acre state. The study was carried out between September and November 2011 (Fig. 1) [16].

2.1. Sample characteristic

At the time of the study, 712 rubber tappers were registered at the factory as suppliers of latex. However, during the period of data collection, only 398 rubber tappers had active registrations, i.e. were effectively supplying the raw material. Of this total, 340 workers were interviewed at the places in the forest where the cooperative collects the latex. The remaining workers could not be contacted, mainly owing to difficulties accessing the rubber plantations during the rainy season. The number of rubber tappers interviewed represented 85.4% of the target population of 14 rubber plantations, thereby ensuring representativeness of the sample.

In addition, 160 workers at the cited factory were included, 148 (92.5%) of whom were interviewed. The workers were drawn from the following sectors: packing, electrical testing, maintenance, production, administration and cleaning. Besides the rubber tappers, only the administrative personal used to work in permanent day shift. All the other categories had to work in a rotating shift work.

All interviews took place at the factory during work hours at a venue which provided comfort and privacy. Therefore, the sample is representative and accurately reflects the characteristics of the population studied (Table 1) [17].

2.2. Variables

Data on sociodemographic characteristics, anthropometry (body mass and height), life-style, sleep, self reported morbidities, musculoskeletal pain and occupation type were reported by the workers.

2.3. Sociodemographic data, life habits and morbidity

The following sociodemographic aspects were included: age, sex, marital status and presence of children at home. The variables related to life-style were: smoking, alcohol use and practice of physical exercise outside work hours.

The information on practice of physical exercise was collected through the following questions: “Do you practice physical exercise during your free time? ” (No;Yes); “If yes, which exercises? ” and “How many times a week? ” (once a week, 2–3 times a week and over 3 times a week).

In order to identify the frequency of morbidities, the items from the Work Ability Index (WAI) questionnaire [18,19] were included, collecting information on the occurrence of clinician-diagnosed diseases in the past 12 months.

2.4. Karolinska Sleep Questionnaire

The Karolinska Sleep Questionnaire (KSQ) was used to assess sleep disturbances reported by the workers over the past six months. The

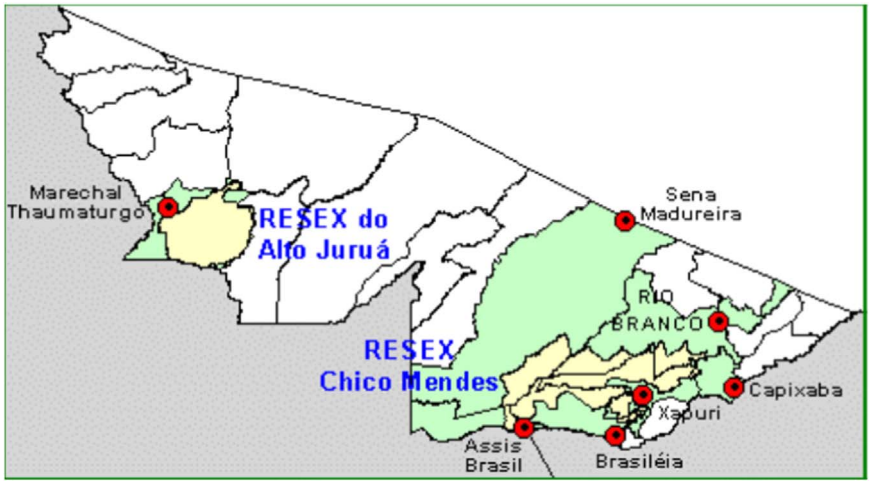

Fig. 1. Map of Acre state and location of the Chico Mendes Extractivist Reserve (RESEX). Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Não Renováveis [IBAMA], 2006.

Table 1
Shift type and working times of study participants (n=488).

Type of work	Type of activity[a]	Sector	Shift type	Work hours	n
Factory	Moderate	Electrical testing and packing	Rotating	14:00–23:00 h 06:00–15:00 h 22:00–07:00 h	70
Factory	Moderate	Production	Rotating	06:00–18:00 h 18:00–06:00 h	10
Factory	Moderate	Maintenance	Rotating	08:00–20:00 h 20:00–08:00 h	11
Factory	Low	Administrative	Day	08:00–18:00 h	46
Factory	Moderate	Cleaning	Rotating	06:00–14:00 h 14:00–22:00 h	11
Rubber tapper	High	Extractivism	Day	05:00–17:00 h	340

[a] Classification by metabolic rate according to Brazilian Bylaws no 15 (BRASIL, 1978).

KSQ contains 15 questions on sleep problems covering three dimensions: sleep disturbances; fatigue/non-restorative sleep and waking difficulties. This KSQ is a Likert type scale containing five response alternatives ranging from 1 to 5 with verbal anchors (never, rarely, sometimes, frequently and always) [20]. Each dimension was categorized after classification as "yes" for frequently/always or "no" for never/rarely/never. In this study we analyzed sleep disturbances, which were comprised difficulties initiating asleep; waking several times and difficulty getting back to sleep; too early final waking; disturbed sleep.

The internal reliability of the instrument in this study was 0.81 according to Cronbach's Alpha.

2.5. Nordic Questionnaire for the analysis of musculoskeletal symptoms

The Nordic Questionnaire was used to assess musculoskeletal pain [21]. This questionnaire comprises questions on work-related musculoskeletal pain/discomfort reported over the previous 12-month period. The general questionnaire assesses the following body regions: neck, shoulder, upper part of the back, lower part of the back, knuckles and hands, hips and thighs, knees, ankles and feet. The internal reliability of the questionnaire was tested using Cronbach´s Alpha, yielding 0.93 in the present study. The figure of a human being highlighting parts of body was shown to the participant in order to help him/her to identify the body regions.

2.6. Body Mass Index (BMI)

For the assessment of nutritional status, data on reported body mass and height were self-reported to calculate body mass index (BMI) based on the formula: BMI=body mass/height^2. The workers were classified using the reference values published by the World Health Organization [22], according to the criteria: < 18.5 kg/m^2 for "underweight"; 18.5–24.9 kg/m^2 for "normal"; 25.0–29.9 kg/m^2 for "overweight"; and ≤ 30 kg/m^2 for "obesity". The dichotomous variable "overweight or obesity" was employed for analyses. Participants were classified into "normal" (BMI < 25 kg/m^2) or "overweight or obesity" (BMI ≥ 25 kg/m^2).

2.7. Statistical analysis

A logistic regression model was estimated based on the stepwise forward method, with the outcome variable "presence of sleep disturbances", a dimension from the previously cited KSQ. The independent variables were selected using the Pearson´s Chi-squared test, selecting variables with a p-value < 0.20. Variables attaining a p-value < 0.05 were retained in the final model. The Stata13 software program (Stata Corporation, College Station, TX, USA) was used for all analyses.

2.8. Ethical aspects

The ethical aspects were based on the norms of the National Health Council in Resolution no. 196 of 10th October 1996 [23], in compliance with the ethical standards of the Declaration of Helsinki. The project was approved by the Research Ethics Committee of the School of Public Health of the University of São Paulo (Protocol no. 2273) and all participants signed an informed consent form in duplicate, with one copy retained by the participant and the other filed by the researcher.

3. Results

The data revealed the rubber tappers (high physical activity) group to be predominantly male (91.5%), with mean age of 42 years (SE=0.76) and age range of 18–72 years. Notably, 27.3% of the rubber tappers were illiterate and 64.7% had not completed primary education.

Among the factory workers (low/moderate physical activity), there was an equal proportion of males (52%) and females (48%), and 68% of interviewees had completed secondary education. These workers had a mean age of 27.1 years (SE=0.5) and age range of 18–55 years.

The two groups (high vs. low/moderate physical activity) were different in all analyzed variables excepted for alcohol use. There was a significant age difference between the groups, rubber tappers being older than the factory workers (Table 2).

The prevalence of sleep disturbances among high vs. low/moderate physical activity workers was 27.9% and 15.5%, respectively (p=0.003). No statistically significant difference was found between the groups for reported morbidities. Workers with high physical activity with more than five musculoskeletal complaints were twice the number of those with low/moderate physical activity at work ($p < 0.001$) (Fig. 2).

The following factors were associated with the presence of sleep disturbances according to Pearson's Chi-squared test ($p < 0.20$): sex (p=0.074), marital status (p=0.014), age > 40 years ($p < 0.001$), type of job – with high physical activity ($p < 0.003$), smoking ($p < 0.006$), 5 or more musculoskeletal complaints ($p < 0.001$), presence of 3 or more reported morbidities (p=0.002). These variables were selected as independent variables for the logistics regression model.

Multiple regression analysis identified the following predictors for sleep disturbances (presented in the order of entrance in the model): sex (female); age (> 40 years), having musculoskeletal pain (≥ 5 symptoms); type of job (high physical activity). The variables marital status, smoking and presence of ≥ 3 reported morbidities were no longer significant in the final model (Fig. 3).

4. Discussion

The results of this study revealed a high prevalence of sleep disturbances among rubber tappers with high physical activity (27.9%) compared to factory workers with low/moderate physical

Table 2
Socio-demographic, life-style and health characteristics according to degree of physical activity (n=488).

Variable	Categories	High physical activity (rubber tappers)		Low/moderate physical activity (factory workers)		p (χ2)
		N	%	N	%	
Sex	Male	311	91.5	77	52	**p < 0.001**
	Female	29	8.5	71	48	
Age	18–30 years	82	24.1	116	78.4	**p < 0.001**
	31–40 years	85	25.0	26	17.6	
	> 40 years	170	50.0	6	4.1	
Marital Status	Single	92	27.1	91	61.5	**p < 0.001**
	Married/live with partner	248	72.9	57	38.5	
Practice physical exercise	Yes	127	37.4	90	60.8	**p < 0.001**
	No	213	62.6	58	39.2	
Smoking	Yes	169	49.7	19	12.8	**p < 0.001**
	No	171	50.3	129	87.2	
Alcohol use	Yes	173	50.9	88	59.5	n.s.
	No	167	49.1	60	40.5	
Nutritional Status	Normal	240	72.3	83	57.2	**p=0.001**
	Overweight/ Obesity	92	27.7	62	42.8	

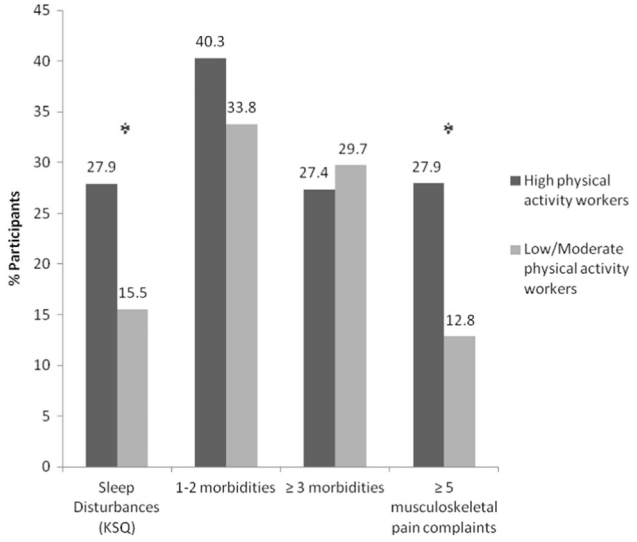

Fig. 2. Frequency of sleep disturbances (KSQ), reported morbidities and musculoskeletal pain among high and low/moderate physical activity (n=488). Pearson's Chi-square test, *p < 0.05.

activity (15.5%). This finding corroborates the results of the study by Moreno et al. [24] in which rubber tappers' job was associated with insomnia. One hypothesis to explain our findings is that the intense physical effort of the work may lead to musculoskeletal pain and in turn to sleep disturbances. In addition, we should consider the age differences between groups, which also may contribute to sleep disturbances. However, the cross-sectional nature of this study precluded the establishment of a cause and effect relationship for the results outlined.

Findings reported in the literature regarding the effects of physical exercise during leisure time on sleep quality have shown an opposite effect [25,26]. Vuori et al. [27], for instance, have shown that mild-to-

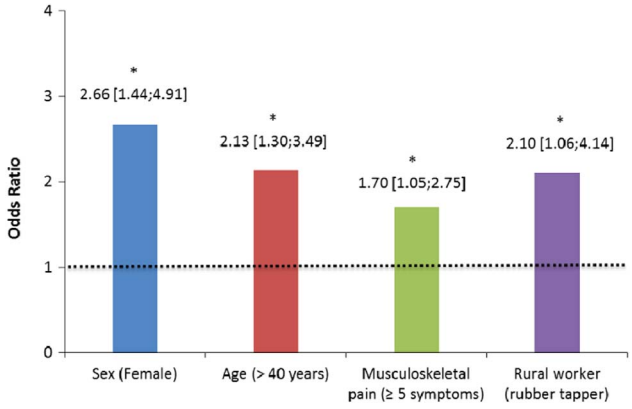

Fig. 3. Final logistic regression model according to presence of sleep disturbances (KSQ) in the study sample (n=488). Dashed line at 1 means reference cut-off. *p < 0.05 OR [CI95%].

moderate activities exert a positive effect on sleep quality. On the other hand, the same authors found a negative impact of vigorous physical exercise on sleep. Perhaps this is similar to what occurs during intense physical effort at work. A study by Marqueze et al. [28] of workers in the ceramic industry showed a tendency for worse sleep quality indexes in the presence of greater energy expenditure of the workers, particularly in the case of physically demanding labor activities. Soltani et al. [29] suggested that work requiring intense physical effort may constitute an independent factor influencing sleep quality although this relationship has not yet been fully elucidated.

Physical inactivity, however, is considered one of the main risk factors for the development of a number of chronic noncommunicable diseases, such as cardiovascular disease, diabetes, osteoporosis and some types of cancer [30]. Pursuing a physically active life, especially during leisure time, substantially reduces the risk for these diseases and promotes many health benefits such as lower corporal adiposity; improved cardiovascular and musculoskeletal health; reduced levels of anxiety and depression, among others [31].

According to data from the 2008 National Households Survey (PNAD), one out of every five Brazilians practiced no physical activity. Moreover, particularly in the North and Northeast regions of the country, physical activity is performed in the process of travelling to work among younger men with lower educational level, and thus is practiced out of necessity rather than as an option for improving quality of life [32].

Another aspect evident in our findings was the association between musculoskeletal pain symptoms and sleep disturbances among the workers. Rural work that is physically demanding is known to promote musculoskeletal injuries, where pain can lead to more serious and debilitating health issues, such as repetitive strain injury (RSI) and work-related musculoskeletal disorders (WMSD), caused by poor posture, long periods standing, heat discomfort and long work shifts [33].

Moreno et al. [24] also highlighted that the presence of organic and mental diseases can lead to more musculoskeletal complaints. According to Lima et al. [34], in a study of rural workers engaged in coffee harvesting, the field work involves dangerous and stressing working conditions which, together with musculoskeletal pain, can lead to the development of anxiety and depression as well as to a decline in the quality of sleep.

The work activity of rubber tappers is integrated with nature. In general this group has no direct contact with modern society's life-style such as access to the internet and/or television, since most of them do not even have electricity at home [35]. These workers start working at around 05:00 h and end in the late afternoon. The factory workers, on the other hand, although living in the same region, have incorporated some of the characteristics of modern society into their everyday lives,

since they work shifts (including night work). There has been a change in the relationship with work, as well as in remuneration, which is dictated by the social clock as opposed to the rhythms imposed by nature, as is the case for activities of hunting, fishing and Brazilian nut and latex extraction [36]. Thus, an important aspect to consider is that the workers involved in this study have different living and work conditions.

In this scenario, the relationship between exhausting physical effort and musculoskeletal pain may be one of the possible explanations for the findings concerning predictors of risk for sleep disturbances among the workers studied. This is particularly true for rubber tappers, providing an intriguing contrast with factory workers: despite working in a setting of sedentary, factory and shift-based work (including nights), factory workers showed lower risk of developing sleep disturbances. However, we must emphasise that the rubber tappers were mostly older than the factory workers. Being older than 40 was found to be a risk factor for sleep disturbances as well as work with high physical activity. A relationship between sleep disorders and advanced age has been reported, with a reduction in total time and sleep efficiency as we age [37,38]. On the other hand, Grandner et al. [39] after analyzing the United States Behavioral Risk Surveillance System Factor data found that older individuals were less likely to report problems related to sleep when compared to young and middle-aged adults. The authors thus suggested that the increased reporting of sleep disorders with age is not a linear phenomenon, and can be mediated by factors other than aging such as general health and presence of morbidities. These present findings suggest that the variables related to age, life-style and work should be analyzed together, i.e. the working times and physical work conditions in general constitute part of the individual's life-style. Physical effort at work may have a deleterious effect on sleep, particularly when associated with life-style characteristics which reduce sleep quality, such as the environment for sleeping. There is still a gap in the literature regarding the sleep of workers living in remote areas, although recent studies have shown sleep habits in hunter-gatherers [40].

Being female was also identified as a predictor of sleep disturbances. This result corroborates previous findings in the literature on this subject [41,42]. In a study of sleep disturbances among adults, Zanutto et al. [43] also found greater occurrence among women. This phenomenon may be explained based on two different perspectives: from a biological standpoint females have more fragmented sleep than males [44]; also socially, women are subject to multiple responsibilities involving work, family etc., creating stress which can negatively impact sleep [45]. In conclusion, rubber tappers reported a high prevalence of sleep disturbances, partly a result of demanding physical work, age, pain and musculoskeletal fatigue.

Conflicts of interest statement

We declare no conflicts of interest.

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